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DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
Washington, D.C. 20314-1000

ER 1110-1-8100

Regulation  
No. 1110-1-8100

31 December 1997

Engineering and Design  
LABORATORY INVESTIGATIONS AND TESTING

1. **Purpose.** This regulation prescribes the responsibilities, policies, and procedures for laboratory investigations, materials and chemistry testing, and analytical services performed in support of design, construction, and operation of Civil Works, Military, and Support-for-Others programs.
2. **Applicability.** This regulation is applicable to all USACE commands having responsibilities for the planning, design, construction, and operation of Civil Works, Military, and Support-for-Others programs.
3. **References.**
  - a. ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OEW) Activities.
  - b. ER 1110-1-261, Quality Assurance of Laboratory Testing Procedures.
  - c. ER 1110-1-263, Chemical Data Quality Management for Hazardous Waste Remedial Activities.
  - d. ER 1110-1-2002, Cement, Slag, and Pozzolan Acceptance Testing.
  - e. ER 1110-2-8154, Water Quality Management at Corps Civil Works Projects.
  - f. ER 200-2-3, Environmental Compliance Policies
  - g. EM 200-1-6, Chemical Quality Assurance for HTRW Projects.
  - h. EM 385-1-1, Safety and Health Requirements Manual.
4. **Distribution.** Approved for public release, distribution is unlimited.
5. **Definitions.**
  - a. Contractor Quality Control (CQC). The contractor's system for management and control of his/her own, suppliers', and subcontractors' activities to comply with contract requirements.
  - b. Chemical Quality Control (QC). QC is a specific series of activities for ensuring that data of the required quality will be obtained for a specific project by the

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This regulation supersedes ER 1110-1-8100, 30 Dec 94.

Architecture/Engineering (A/E), Construction Contractor, or the Government (for in-house chemical analyses). Normally this consists of the analysis of field blanks, duplicate and/or split samples. QC also includes the laboratory internal quality control procedures as required by the Laboratory Quality Management Manual (LQMM) and the standard operating procedures (SOPs).

c. Quality Assurance (QA). The system by which the Government, through reviews, inspections, and tests, assures that the CQC, QC, or materials testing in support of planning and design is functioning and the specified end product is realized.

(1) Geotechnical and Materials Quality Assurance. The testing, evaluations, and inspections performed by the Government in verifying: (a) that the contractor's performance is in compliance with the contract requirements; (b) that the end results meet design criteria as required by the appropriate engineering division; and (c) that the contractor's laboratory equipment, personnel, and procedures are adequate for quality control.

(2) Chemical Quality Assurance (CQA) and Chemical Data Quality Management (CDQM). The Government activities required to assure desired and verifiable levels of quality in chemical data for a specific project. The activities associated with CQA and CDQM for HTRW are defined in ER 1110-1-263 and EM 200-1-6.

d. Chemistry and Materials Quality

Assurance Laboratory (CMQAL). CMQAL is established in Omaha, Nebraska having the primary missions of furnishing chemistry QA and chemical analytical services in support of Chemical Data Quality Management (CDQM) for HTRW investigative and remedial activities, and providing chemical analytical services and laboratory inspection for water quality investigations.

e. Materials Testing Center (MTC).

A center established at the U. S. Army Engineer Waterways Experiment Station (CEWES) to provide materials testing (soil, rock, concrete, asphalt, and other construction materials) and inspection and validation of CQC labs, project materials QA laboratories, and contracted commercial materials testing laboratories, as required in ER 1110-1-261.

f. Environmental Laboratory

(CEWES-EE). A laboratory at the Waterways Experiment Station having chemical testing and analytical services capability may supplement the services of CMQAL.

g. Project Materials QA Laboratory.

A laboratory established at a construction project site to provide required Government Quality Assurance testing for verification of design criteria and confirmation of compliance of materials and construction procedures with specifications. This includes the materials QA laboratory staffed by Government personnel or commercial materials testing laboratory used to perform Government QA testing.

h. Commercial Laboratory. A privately owned and operated laboratory providing materials testing and evaluation or chemical analytical services. (NOTE: Commercial laboratories providing chemical analyses in support of a specific HTRW remediation activity have also been termed "Project Laboratories." However, the term "primary laboratory" will be adopted to avoid confusion.).

6. Policy.

a. CMQAL and MTC are USACE corporate resources and their testing facilities and QA services are provided on a Corps-wide basis in a quality, responsive, and cost-effective manner. All Corps district offices are strongly encouraged to use these resources for laboratory investigations, chemistry and materials testing in support of project investigation, design, construction, and operation of Civil Works, Military, and Support-for-Others programs.

b. It is mandatory that all construction CQC labs, contracted commercial materials testing laboratories, and project materials QA laboratories be inspected and validated for materials testing by MTC in accordance with ER 1110-1-261.

7. Chemistry and Materials Quality Assurance Laboratory and Materials Testing Center.

a. Mission and Scope. The assigned missions of CMQAL and MTC are as follows:

(1) CMQAL

(a) Furnish QA/QC chemistry testing and evaluation services in support of planning, design, construction, and operation of Civil Works, Military, and Support-for-Others programs.

(b) Provide QA services for water, air, soil, sediment, sludge, and wastewater investigations performed at project and commercial laboratories.

(c) Provide chemical data quality management (CDQM) services in support of HTRW remediation activities. CDQM for HTRW activities is provided in ER 1110-1-263.

(d) Provide soil properties testing for contaminated soils.

(e) At the request of MTC, provide technical supervision, inspection, and validation of CQC labs, contracted commercial materials testing labs providing CQC services and project materials QA labs.

(f) At the request of HTRW CX, conduct Performance Evaluation (PE) Sample Program activities, provide technical support for the HTRW CX, provide training, complete bench scale studies and compatibility testing, and inspect commercial chemistry laboratories.

(g) The chemistry testing capability of CMQAL may be supplemented by the Environmental Laboratory of the Waterway Experiment Station (CEWES-EE) and

qualified commercial laboratories.

(2) MTC

(a) Furnish materials testing and evaluation services and QA in support of planning, design, construction, and operation of Civil Works, Military, and Support-for-Others programs.

(b) Perform acceptance tests on construction materials requiring special skills and equipment not generally available or authorized at project materials QA laboratories.

(c) Provide inspection and validation of all contractor CQC laboratories and contracted commercial materials testing laboratories providing CQC services required by the construction specification.

(d) Provide inspection and validation of project materials QA labs.

(e) Provide inspection, evaluation, and QA of contracted commercial materials testing laboratories performing materials testing in support of planning and design.

(f) Maintain all laboratory inspection records for four (4) years from date of inspection or as otherwise deemed necessary.

(g) Perform special materials investigations for project-related needs.

(h) CEWES is assigned sole responsibility for the cement, slag, and pozzolan testing program as per

ER 1110-1-2002 and for waterstops and preformed joint materials testing.

b. Organization. Management oversight of CMQAL shall be provided by HQUSACE (CERD) and the management oversight of MTC shall be the responsibility of CEWES Executive Office.

c. Authorized Testing and Evaluation Capabilities. Appendix A summarizes the service responsibilities for CMQAL and MTC. In accordance with ER 1110-1-263, the HTRW CX has the primary responsibility for the implementation of Chemical Data Quality Requirements. These requirements include the validation of CMQAL and other laboratories (Government or commercial) performing HTRW chemistry testing services.

d. Contracting for Laboratory Testing and Analytical Services. When the workload exceeds the capability of CMQAL or MTC, qualified commercial laboratories meeting the requirements of paragraph 9 may be used.

e. In-House Quality Assurance Inspections. As part of the in-house quality assurance program, concrete and concrete materials capabilities at MTC will be inspected at least biennially by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology (NIST). The soil capabilities at MTC will be inspected at least biennially by the American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL) of the NIST. For HTRW chemical quality

assurance, the HTRW CX shall provide performance validation samples on an 18-month basis and shall perform on-site inspections and evaluation of CMQAL QA procedures and HTRW chemistry capability on a scheduled basis. HQUSACE (CEMP-RT) will receive a copy of the inspection report.

f. Audit of CMQAL and MTC. HQUSACE proponents will provide a biennial review and audit of CMQAL and MTC. This audit will examine the capabilities and related workload level to determine the adequacy of technical expertise and staffing. It will also provide guidance in problems experienced by the laboratories.

g. HQUSACE Laboratory Steering Committee. A Laboratory Steering Committee (LSC) consisting of representatives from CERD, CECW-EG, CECW-OC, CEMP-RT, and CEMP-CE will be established in the HQUSACE. The LSC will be chaired by CERD and will provide centralized program oversight, review, and coordination of CMQAL and MTC performing chemistry and materials testing. The LSC will monitor laboratory performance, including customer care, fiscal accountability, quality, and responsiveness.

h. Customer-Care Survey. CMQAL and MTC shall be committed to maintaining and continually improving the quality of services to customers. A Customer-Care Survey provided in Appendix B shall be sent to a customer with each project data package to obtain customer feedback. CMQAL and

MTC shall submit an annual Summary Report of Customer-Care Survey to CERD by 15 October each year.

8. Project Materials QA Laboratories.

a. Mission and Scope. Project materials QA laboratories, when established, shall perform required quality assurance testing for verification and confirmation of compliance of materials and construction procedures with specifications. Tests performed and equipment provided shall be determined by the nature and scope of the project. Tests performed at project materials QA laboratories shall be limited to the types of services normally required in support of Government QA and miscellaneous construction activities. Services not available at the project materials QA laboratory will be provided by MTC or qualified commercial laboratories.

b. Organization. A project materials QA laboratory will be part of the area, resident, or project engineer's organization. The area, resident, or project engineer shall be responsible for maintaining a well trained and qualified laboratory staff and sufficient testing equipment (calibrated and in good working condition). The project materials QA laboratory shall be included in the area, resident, or project office Quality Assurance Plan.

c. Inspection, Evaluation and Validation. In accordance with ER 1110-1-261, each project materials QA laboratory shall be inspected and validated to meet or conform to the appropriate

standards listed in ER 1110-1-261 for the specified services. The inspection and evaluation shall be performed every two years by MTC.

**9. Commercial Laboratories.**

a. Use. Qualified laboratories meeting the requirements in paragraph 9.b may be used when the testing workload exceeds the capability to meet the project schedule or the technical skills are not available in the CMQAL or MTC.

b. Inspection, Evaluation and Validation.

(1) Commercial Materials Laboratories. Prior to the use of any commercial materials laboratory for testing and/or analytical services, such laboratory shall be inspected and validated for the specified services unless a waiver is granted by HQUSACE (CECW-EG). The inspection and validation shall be performed by MTC.

(2) Commercial Chemistry Laboratories. In the case of chemical analytical support for HTRW remediation activities, HTRW CX has the sole responsibility for inspection and validation of Government and commercial chemistry laboratories. Commercial laboratories must meet or conform to the requirements set forth in ER 1110-1-261 and ER 200-2-3. For projects involving the removal of underground storage tanks (UST) that have contained only petroleum, oils, or lubricants, there are two alternatives to the laboratory validation process: (a) state certified

laboratories may be used without USACE validation or, (b) HTRW CX may delegate certain validation responsibilities to CMQAL.

10. **Special Tests and Investigations.** Tests, analyses, and investigations for planning, design, construction, and operation that are outside the capabilities of the CMQAL or MTC shall be arranged for, insofar as possible, with the Corps research laboratories. For tests and investigations beyond the scope of Corps research laboratories, the MSC commander is authorized to arrange for the work to be performed by other Federal and state agencies, universities, or commercial organizations.

**11. Reports of Investigations and Tests.**

a. General. Reports on laboratory tests and investigations shall present test results and, when appropriate, explanations of testing procedures used and interpretations of test results.

b. Acceptance Tests. A report on acceptance tests for a construction material shall indicate whether the material meets the specification requirements, but in no case shall the laboratory be authorized to approve or disapprove such material.

c. Water and Wastewater Studies. In accordance with ER 1110-2-8154 and ER 200-2-3, reports on water and wastewater investigations shall present the results of laboratory analyses, quality control, and quality assurance data, and shall provide a written description of the methods of

analyses employed.

d. HTRW Chemical Testing and Analysis. All analytical reports associated with HTRW investigation and remediation activities shall follow the guidelines set forth in ER 1110-1-263 and USACE minimum data reporting requirements as set forth in EM 200-1-6.

**12. Unit Price Test Costs.**

a. General. Unit test prices shall be set and published on an annual basis and become effective on 1 October of each year. Four copies of the updated Unit Test Price Schedule shall be submitted to HQUSACE (CERD) no later than 15 September each year.

b. Regular Tests. Prices for regular tests and analyses (test and analyses performed on a regular basis) shall be determined based on both the projected workload and the cost of operation (cost for materials and supplies required for the test, cost of the employee performing the test, time required to perform the test, plant increment, depreciation, and administrative support) as the projected work load may affect efficiency and hence, cost of operation.

c. Special Tests. Costs for special tests and analyses shall be charged on a cost-reimbursable basis.

**13. Safety and Health.**

a. Safety and health hazards, if

encountered, shall be identified and evaluated during the course of testing or investigations, and actions shall be taken for their control or elimination in accordance with ER 385-1-92 and EM 385-1-1.

b. A permanent record of Material Safety Data Sheets (MSDS) shall be maintained and available for immediate reference. MSDSs shall be located at strategic locations (such as next to the safety shower or eyewash) throughout the laboratory.

c. Employee training plans for spill prevention and emergency action shall be documented. Regular training, and safety meetings are required as specified in EM 385-1-1.

d. Laboratory personnel shall wear clothing suitable for the working conditions and shall use any personal protective equipment and clothing which may be required to maintain their exposure within acceptable limits.

e. A Chemical Safety and Hygiene Plan is required for all laboratory operations. The plan shall include an initial assessment of all workers for the types of occupational hazards and chemicals to which they may be exposed. The plan must be written and posted in prominent locations throughout the laboratory.

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31 Dec 97

FOR THE COMMANDER:



OTIS WILLIAMS  
Colonel, Corps of Engineers  
Chief of Staff

2 Appendices  
APP A - Authorized Testing  
and Evaluation Capabilities  
APP B - Customer-Care Survey

**Appendix A**  
**Authorized Testing and Evaluation Capabilities**

CAPABILITY	CMQAL	CEWES (MTC)
Chemistry <sup>1</sup> (WQ)	X	
Chemistry <sup>2</sup> (HTRW)	X	
Soils <sup>3</sup> (HTRW)	X	X
Soils <sup>4</sup> (Conventional)		X
Soils <sup>5</sup> (Special)		X
Concrete and Materials <sup>6</sup>		X
Engineering Geology <sup>7</sup> and Rock Mechanics <sup>8</sup>		X

- [1] Water quality and wastewater quality chemical analyses and testing.
- [2] Chemical analyses associated with HTRW investigation and remediation activities.
- [3] Soils properties testing for contaminated soils.
- [4] Conventional soil mechanics testing.
- [5] Specialized soil mechanics testing (e.g. cyclic triaxial, large specimen (> 6-inch diameter) tests, etc.)
- [6] Concrete, concrete aggregates, asphalt, masonry, chemical admixtures, and miscellaneous materials.
- [7] Petrography, riprap and armor stone investigations, and quarry evaluations.
- [8] Unconfined compression, direct shear, triaxial shear, tensile tests, elastic constants, etc. on soft and hard rocks.

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Appendix B  
Customer-Care Survey

## CUSTOMER CARE SURVEY

<b>LABORATORY QUALITY/CUSTOMER SATISFACTION SURVEY</b>															
<b>INFORMATION</b>	<b>PROJECT INFORMATION</b>														
Customer _____	Project No. _____  Project Name _____  _____														
<b>LABORATORY INFORMATION</b>															
Laboratory _____ Date of Report _____ Completion _____	Laboratory Point of Contact _____  _____														
<b>INTRODUCTION</b>															
<p>The Materials Testing Center (MTC) at CEWES, and the Chemistry and Materials Quality Assurance Laboratory (CMQAL) are committed to maintaining and continually improving the quality of our services and products we offer. We define quality as meeting customer objectives. Therefore, the best measure of our performance is our customers' level of satisfaction.</p> <p>We would like to ask you to help us by answering a few short questions that rate our performance on a scale of 1 to 5. A rating of "1" indicates totally unsatisfactory performance, a "3" is satisfactory, a "5" means outstanding, and a N/A indicates this was not applicable for the services provided. Please check appropriate box.</p>															
<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="6" style="text-align: center; padding: 2px;">RATING</th> <th style="text-align: center; padding: 2px;">SCORE</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px;">1</td> <td style="text-align: center; padding: 2px;">2</td> <td style="text-align: center; padding: 2px;">3</td> <td style="text-align: center; padding: 2px;">4</td> <td style="text-align: center; padding: 2px;">5</td> <td style="text-align: center; padding: 2px;">N/A</td> <td style="text-align: center; padding: 2px;"></td> </tr> </tbody> </table>		RATING						SCORE	1	2	3	4	5	N/A	
RATING						SCORE									
1	2	3	4	5	N/A										
1. QUALITY: What was the technical quality of the data , including clarity, presentation, organization, and completeness?															
2. TIMELINESS: Was the data received by the original or adjusted deadline?															
3. COST: Was the overall cost reasonable and was it in line with what was agreed upon?															
4. COMMUNICATIONS: Were you kept adequately informed of job progress and were our contacts courteous and responsive?															
5. CONSULTING SERVICES: What was the value of technical assistance provided above/beyond laboratory testing services, if required?															
How do you rate your <u>OVERALL SATISFACTION</u> for the services and products provided to you by our laboratory?															
<b>TOTAL SCORE</b>															

**Customer Comments:****CLOSING**

Thank you very much for your time. We very appreciate your willingness to help us. [When appropriate: The issues raised will be addressed promptly.]

We would like to ask one final question: What changes would you recommend that the laboratory make to improve its service to you?

Again, thank you.

Survey conducted by \_\_\_\_\_

**FOLLOW UP ACTION**

What and How:

Distribution:

  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Who: \_\_\_\_\_ By When: \_\_\_\_\_

REVIEWER

Signature \_\_\_\_\_ Date \_\_\_\_\_